Ameren MISSOURI

Callaway Plant

February 9, 2021

ULNRC-06635

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555-0001

10 CFR 50.73

Ladies and Gentlemen:

**DOCKET NUMBER 50-483**
**CALLAWAY PLANT UNIT 1**
**UNION ELECTRIC CO.**
**RENEWED FACILITY OPERATING LICENSE NPF-30**
**LICENSEE EVENT REPORT 2020-002-01**
**REACTOR TRIP AND AFW ACTUATION FOLLOWING SPURIOUS MFRV CLOSURE**

The enclosed licensee event report is submitted in accordance with 10 CFR 50.73(a)(2)(iv)(A) to report a reactor trip and auxiliary feedwater (AFW) actuation following the spurious closure of the 'C' main feedwater regulating valve (MFRV). This LER supplement/revision is being submitted to provide the results of the cause determination and corrective actions.

If you have any questions concerning this LER, please contact Tom Elwood, Supervising Engineer, Regulatory Affairs and Licensing at (314) 225-1905.

This letter does not contain new commitments.

Sincerely,

Fred Bianco
Senior Director, Nuclear Operations

Enclosure: LER 2020-002-01

cc: Mr. Scott A. Morris
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U. S. Nuclear Regulatory Commission
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NRC FORM 366 (08-2020) U.S. NUCLEAR REGULATORY COMMISSION

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# LICENSEE EVENT REPORT (LER)

(See Page 3 for required number of digits/characters for each block)

(See NUREG-1022, R.3 for instruction and guidance for completing this form https://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1022/r3/)

| 1. Facility Name | 2. Docket Number | 3. Page |
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| Callaway Plant Unit 1 | 05000483 | 1 OF 4 |

**4. Title**

Reactor Trip and AFW Actuation Following Spurious MFRV Closure

| 5. Event Date | | | 6. LER Number | | | 7. Report Date | | | 8. Other Facilities Involved | |
|---|---|---|---|---|---|---|---|---|---|---|
| Month | Day | Year | Year | Sequential Number | Revision No. | Month | Day | Year | Facility Name | Docket Number |
| | | | | | | | | | | 05000 |
| 04 | 04 | 2020 | 2020 | - 002 - | 01 | 02 | 08 | 2021 | Facility Name | Docket Number |
| | | | | | | | | | | 05000 |

| 9. Operating Mode | 10. Power Level |
|---|---|
| 1 | 100 |

**11. This Report is Submitted Pursuant to the Requirements of 10 CFR §: *(Check all that apply)***

| | | | | |
|---|---|---|---|---|
| **10 CFR Part 20** | ☐ 20.2203(a)(2)(vi) | ☐ 50.36(c)(2) | ☒ 50.73(a)(2)(iv)(A) | ☐ 50.73(a)(2)(x) |
| ☐ 20.2201(b) | ☐ 20.2203(a)(3)(i) | ☐ 50.46(a)(3)(ii) | ☐ 50.73(a)(2)(v)(A) | **10 CFR Part 73** |
| ☐ 20.2201(d) | ☐ 20.2203(a)(3)(ii) | ☐ 50.69(g) | ☐ 50.73(a)(2)(v)(B) | ☐ 73.71(a)(4) |
| ☐ 20.2203(a)(1) | ☐ 20.2203(a)(4) | ☐ 50.73(a)(2)(i)(A) | ☐ 50.73(a)(2)(v)(C) | ☐ 73.71(a)(5) |
| ☐ 20.2203(a)(2)(i) | **10 CFR Part 21** | ☐ 50.73(a)(2)(i)(B) | ☐ 50.73(a)(2)(v)(D) | ☐ 73.77(a)(1)(i) |
| ☐ 20.2203(a)(2)(ii) | ☐ 21.2(c) | ☐ 50.73(a)(2)(i)(C) | ☐ 50.73(a)(2)(vii) | ☐ 73.77(a)(2)(i) |
| ☐ 20.2203(a)(2)(iii) | **10 CFR Part 50** | ☐ 50.73(a)(2)(ii)(A) | ☐ 50.73(a)(2)(viii)(A) | ☐ 73.77(a)(2)(ii) |
| ☐ 20.2203(a)(2)(iv) | ☐ 50.36(c)(1)(i)(A) | ☐ 50.73(a)(2)(ii)(B) | ☐ 50.73(a)(2)(viii)(B) | |
| ☐ 20.2203(a)(2)(v) | ☐ 50.36(c)(1)(ii)(A) | ☐ 50.73(a)(2)(iii) | ☐ 50.73(a)(2)(ix)(A) | |

☐ **Other** (Specify here, in Abstract, or in NRC 366A).

**12. Licensee Contact for this LER**

| Licensee Contact | Phone Number (Include Area Code) |
|---|---|
| T.B. Elwood, Supervising Engineer, Regulatory Affairs and Licensing | 314-225-1905 |

**13. Complete One Line for each Component Failure Described in this Report**

| Cause | System | Component | Manufacturer | Reportable To IRIS | Cause | System | Component | Manufacturer | Reportable To IRIS |
|---|---|---|---|---|---|---|---|---|---|
| B | SJ | FCV | S073 | Y | | | | | |

| 14. Supplemental Report Expected | | 15. Expected Submission Date | Month | Day | Year |
|---|---|---|---|---|---|
| ☒ No | ☐ Yes (If yes, complete 15. Expected Submission Date) | | | | |

**16. Abstract** (Limit to 1560 spaces, i.e., approximately 15 single-spaced typewritten lines)


On April 4, 2020 at 0115, an automatic reactor trip and auxiliary feedwater actuation occurred at Callaway Plant (Callaway) following malfunction of the 'C' main feedwater regulating valve (MFRV). Following the reactor trip, the plant safety systems responded per design. The malfunction of the 'C' MFRV was caused by a failure of the primary valve positioner in conjunction with a failure of the backup positioner to automatically assume the control function. The failure of the primary valve positioner resulted in the closure of the MFRV resulting in a low level in the 'C' steam generator.

The physical cause of the positioner failure was a combination of high cycle fatigue of the positioner due to frequent positioner movement demand and the presence of impurities in the instrument air supply to the positioner. The failure of the backup positioner to assume control was attributed to a latent design error introduced during implementation of the modification that installed the positioners. This design error resulted in the inability of the backup positioner to detect an internal failure of the primary positioner and thus initiate automatic swapover of the control function.

The primary positioners for all four MFRVs were replaced prior to resumption of operation. The backup positioner for the 'C' MFRV was verified to be functioning properly. Corrective actions include tuning the main feedwater control system to reduce the frequency of the positioner movement demand, the installation of 5-micron air filters in the instrument air supply to the MFRV positioners and will include a modification of the positioners to address the single-point vulnerability to be implemented in an upcoming refueling outage.

| 1. FACILITY NAME | 2. DOCKET NUMBER | 3. LER NUMBER | | |
|---|---|---|---|---|
| | | YEAR | SEQUENTIAL NUMBER | REV NO. |
| Callaway Plant Unit 1 | 05000-483 | 2020 | - 02 | - 01 |

**NARRATIVE**

1. DESCRIPTION OF STRUCTURE(S), SYSTEM(S) AND COMPONENT(S):

The main feedwater regulating valves (MFRVs) function to control feedwater flow to the steam generators and provide backup isolation of main feedwater (MFW) (EIIS: SJ) flow in the event that a main feedwater isolation valve (MFIV) fails to close. One MFIV (EIIS: ISV) and one MFRV (EIIS: FCV) are located on each MFW line, outside of containment. If the single active failure postulated for a secondary pipe break is the failure of a safety grade MFIV to close, then credit is taken for closing the non-safety grade MFRVs.

Closure of the MFIVs or MFRVs terminates flow to the steam generators, in the event of a feedwater line break (FWLB) occurring upstream of the MFIVs or MFRVs. Since the MFIVs are located upstream of the point where the auxiliary feedwater lines connect to the main feedwater lines, which is in turn upstream of the main feedwater check valves (located in containment), closure of the MFIVs or the MFRVs ensures delivery of auxiliary feedwater to the steam generators in support of the auxiliary feedwater function in the event of a main feedwater line break in the turbine building (i.e., upstream of the MFIVs and MFRVs).

Similarly, the consequences of events occurring in the main steam lines or in the MFW lines downstream from the MFIVs will be mitigated by MFIV or MFRV valve closure. Closure of the MFIVs or MFRVs effectively terminates the addition of feedwater to an affected steam generator, limiting the mass and energy release for a steam line breaks (SLB) or FWLB inside containment, and reducing the cooldown effects for a SLB.

The MFIVs and MFRVs close on receipt of any safety injection signal, a Tavg - Low coincident with reactor trip (P-4), a low-low steam generator level, or steam generator water level - high high signal.

The MFIVs and MFRVs provide the primary success path for events requiring feedwater isolation and isolation of non-safety-related portions from the safety-related portion of the system, so as to provide for auxiliary feedwater addition. Each MFRV actuator (skid-mounted at the valve) has two associated redundant actuation trains. The MFRV positioners serve no function to close a MFRV in response to a feedwater isolation signal. Thus, the malfunction of the 'C' MFRV positioner described in this LER had no impact on the capability of the 'C' MFRV to perform its specified safety function.

The specified safety function of the MFRVs is to provide a diverse backup function to the MFIVs for the potential failure of an MFIV to close, even though the MFRVs are located in the non-safety-related portion of the feedwater system.

2. INITIAL PLANT CONDITIONS:

Callaway was initially in MODE 1 at 100% rated thermal power at the time of this event.

3. EVENT DESCRIPTION:

On April 4, 2020, at 0115 a reactor trip, a Feedwater Isolation Signal, and an Auxiliary Feedwater Actuation Signal to the motor-driven AFW pumps (MDAFAS) occurred due to a 'C' Steam Generator Water Level Low-Low signal. Callaway was initially in MODE 1 at 100% rated thermal power. Annunciator 126F, "Digital Feedwater Trouble," alarmed in the main control room at approximately 0113. The Balance of Plant Operator noted the 'C' steam generator level was lowering with full open demand on the 'C' MFRV. The Balance of Plant Operator took manual control of the 'C' MFRV and attempted to restore 'C' steam generator level. At approximately 0115, with 'C' steam generator level at approximately 30% narrow range (NR), the Control Room Supervisor directed the Reactor Operators to trip the reactor due to the inability to maintain 'C' Steam Generator Level. However, a reactor trip signal was automatically generated from Steam Generator Level Low-Low on 'C' Steam Generator level at approximately 17% NR level before the Reactor Operators were able to manually trip the reactor. Following the reactor trip the crew performed E-0, "Reactor Trip and Safety Injection," and transitioned to ES-0.1, "Reactor Trip Response," to stabilize the plant. The inability to control level in the 'C' steam generator was caused by a malfunction of the primary 'C' MFRV positioner.

The Steam Generator Water Level Low-Low signal generates the following signals:

1. Reactor trip signal
2. Feedwater isolation signal (FWIS)
3. Motor-Driven Auxiliary Feedwater Actuation Signal (MDAFAS) (Low-Low Level signal present on one-out-of-four steam generators)
4. Turbine-Driven Auxiliary Feedwater Actuation Signal (TDAFAS) (Low-Low Level signal present on two-out-of-four steam generators)

The logic for the first three signals was satisfied, and subsequently, a reactor trip signal, FWIS, and MDAFAS were all generated. Subsequent to the start of the motor driven auxiliary feedwater pumps (MDAFPs), level in the other steam generators lowered such that the start logic for the turbine driven auxiliary feedwater pump was satisfied. All auxiliary feedwater pumps started and ran in response to valid signals.

After the reactor trip, the plant safety functions responded as designed. One unexpected component response, which had no bearing on the AFW safety function, was an unexpected opening of ALHV0220, Hardened Condensate Storage Tank Isolation Valve to AFW, when both MDAFPs started on the AFAS. The unexpected opening of ALHV0220 is being evaluated under the station's corrective action program.

The primary valve positioners on all MFRVs were replaced following the reactor trip and noted actuations. Proper functioning of the backup positioner on the 'C' MFRV was verified during troubleshooting activities. All valves were diagnostically tested prior to being released for operation. The station was then restarted in accordance with station procedures. It is noted that the MFRV backup positioners do not assume control automatically upon failure of the primary positioner and the transient event could not be mitigated manually in time to prevent the event reported in this LER.

4. ASSESSMENT OF SAFETY CONSEQUENCES:

The event reported in this LER was a reactor trip and auxiliary feedwater actuation following a malfunction of a MFRV. The plant responded as designed with the exception of the opening of ALHV0220 described previously, and all safety functions were fulfilled in a manner consistent with the plant's safety analysis. The event reported in this LER does not represent an event that significantly degraded the plant's safety.

5. REPORTING REQUIREMENTS:

The event reported in this LER was an event that resulted in automatic actuation of the reactor protection system and the auxiliary feedwater system. This event is reportable as a Licensee Event Report per 10 CFR 50.73(a)(2)(iv)(A), which requires reporting any event or condition that resulted in manual or automatic actuation of any of the systems listed in 10CFR50.73(a)(2)(iv)(B). The reactor protection system and auxiliary feedwater system are both specified in 10 CFR 50.73(a)(2)(iv)(B).

6. CAUSE OF THE EVENT:

The cause investigation determined that the physical cause of the positioner failure was a combination of high cycle fatigue of the positioner associated with positioner movement demand and the presence of impurities in the instrument air supply to the positioner. The failure of the backup positioner to assume control was attributed to a latent design error during implementation of the modification that installed the positioners. This design error resulted in the inability of the positioner swapover function to detect an internal failure of the primary positioner.

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7. CORRECTIVE ACTIONS:

Corrective actions include tuning the main feedwater control system to reduce the frequency of the positioner movement demand, the installation of 5-micron air filters in the instrument air supply to the MFRV positioners and a modification of the positioners to address the single-point vulnerability. The feedwater control system tuning and installation of the air filters in the instrument air supply were completed prior to resumption of operations at the completion of the most recent refueling outage. The modification of the positioner design will be implemented in an upcoming refueling outage. These actions addressed the high cycle fatigue observed on the positioner, ensure an air supply free of dirt or debris that could accumulate in the positioner and cause adverse operation, and will address the inability of the backup positioners to automatically assume control of valve position upon failure of the primary positioner.

Following the reactor trip, all primary MFRV positioners were replaced. Proper functioning of the backup positioner for the 'C' MFRV was verified. All MFRVs were also diagnostically tested before being released to operations for plant startup.

8. PREVIOUS SIMILAR EVENTS:

During the previous three years, there have been no similar events involving spurious closure of a MFRV resulting in a reactor trip and auxiliary feedwater actuation.